IV. STEPDOWN NARRATIVE

The Stepdown Narrative is an outline of recovery actions to facilitate seeing the big picture of the recovery plan. The sequential numbering reflects the timing of recovery actions and their subdivision into more specific component actions, rather than a ranking of their importance. In the Implementation Schedule (Section V below), these actions are sorted by priority number.

Action priorities are defined as:

Priority 1 - an action that must be taken to prevent extinction or to prevent a species from declining irreversibly in the foreseeable future.

Priority 2 - an action that must be taken to prevent a significant decline in the species population/habitat quality or some other significant negative impact short of extinction.

Priority 3 - all other actions necessary to meet recovery or conservation objectives.

1 Protect vernal pool habitat in the largest blocks possible from loss, fragmentation, degradation, and incompatible uses.

Protection of vernal pool habitat is the overarching objective of this recovery plan. Depending on the species and the habitat to be protected, protection of vernal pool habitat may be a Priority 1, 2 or 3 action. Discrete actions (1.1. through 1.3) that contribute to, or are necessary prior to, the actual protection of vernal pool habitat at Priority 1 are, by default, designated as Priority 1 actions as well. This narrative is written in the form of a stepwise formula. The order of the actions is the order in which they should occur and is not a ranking of their relative importance.

For the recovery of species addressed in this recovery plan, we define "vernal pool habitat" to include vernal pool complexes, occupied and unoccupied vernal pools within a vernal pool complex, appropriate upland buffers around and between vernal pools, and local contributing watersheds.

1.1 Develop standardized vernal pool habitat site assessment guidance. (Priority 1)

A standardized, scientifically based methodology should be developed to conduct vernal pool habitat site assessments. It is important to use a standardized methodology to ensure consistency and continuity of data between observers, between vernal pool sites, and over time. A standardized site assessment should, at a minimum, establish parameters that 1) evaluate whether or not the site is within the range of at least one species covered in this recovery plan, 2) evaluate the known localities of each species present on or near the site being assessed, 3) evaluate the historical locations or potential locations of species on or near the site being assessed, 4) evaluate the type and degree of existing, and newly identified, site-specific threats to species occurring on or near the site being assessed, 5) evaluate the habitat conditions in terms of important processes and functions, and 6) evaluate historic and current land use and management regimes as they relate to habitat condition.

1.2 Use existing (and newly available) information to conduct data analysis using Geographic Information Systems, remote sensing, and other techniques to facilitate vernal pool habitat protection efforts. (Priority 1)

Preparation prior to data analysis includes assembling, organizing, and managing all available existing Geographic Information Systems, remote sensing, and other data pertinent to vernal pool habitat protection. Additional Geographic Information Systems, remote sensing, and other data that is lacking, but deemed essential to vernal pool habitat protection, must be obtained. Data must be reviewed and analyzed to determine appropriate habitat to protect (occupied, potential, historical, linkages, buffer areas, *etc*.), the degree of existing protection, and threats to vernal pool habitat. In coordination with the Sacramento Fish and Wildlife Office, a prioritized list of vernal pool habitat to protect should be developed after analyses are completed. The areas with the highest priority for protection are those with the rarest species/genetics, most unique conditions, highest biodiversity, and greatest threat of destruction.

As new data on locations of vernal pool habitat or species occurrences becomes available, it may be used to review the core area boundaries and include additional areas that support occurrences and or suitable habitat. Existing core area boundaries

may also be refined during this process to exclude portions that do not support suitable habitat.

1.3 Conduct standardized vernal pool habitat site assessments (including standardized species surveys, Action 3.2.2)
(Priority 1)

This action serves to identify prioritized sites for protection within each vernal pool region (**Table IV-1**), focusing on core areas initially and working outwards to each vernal pool region boundary.

The vernal pool regions described in this recovery plan are based on the vernal pool regions identified by the California Department of Fish and Game (Keeler-Wolf *et al.* 1998). This classification system should be used as the basis of the Geographic Information Systems approach described above. The vernal pool classification system developed by Keeler-Wolf *et al.* (1998) was chosen because it is widely available, incorporates a variety of information, and encompasses the entire State of California. It is based primarily on the distributions of endemic vernal pool species and secondarily on soils, landforms, and vernal pool types. Included in this recovery plan is a vernal pool region located in Oregon, which is not based on Keeler-Wolf *et al.* (1998). In addition, some vernal pool region boundaries have been modified by incorporating outlying areas that contain core areas important to recovery of certain species. Chapter III, "Recovery" has a detailed description of each vernal pool region, core areas, and explanation for how boundaries were established.

Table IV-1. Areas for vernal pool site assessments.

ACTION	VERNAL POOL REGION	REGION NAME
1.3.1	1	Carrizo
1.3.2	2	Central Coast
1.3.3	3	Klamath Mountains
1.3.4	4	Lake-Napa
1.3.5	5	Livermore
1.3.6	6	Mendocino
1.3.7	7	Modoc
1.3.8	8	Northeastern Sacramento Valley
1.3.9	9	Northwestern Sacramento Valley
1.3.10	10	San Joaquin Valley
1.3.11	11	Santa Barbara
1.3.12	12	Solano-Colusa
1.3.13	13	Southeastern Sacramento Valley
1.3.14	14	Southern Sierra Foothills
1.3.15	15	Western Riverside County
1.3.16	16	San Diego

1.4 Protect vernal pool species through habitat protection.

Protect known species occurrences, newly identified species occurrences, potential species occurrences, and vernal pool habitat, as identified using standardized vernal pool species surveys (Action 3.2.2) and standardized vernal pool habitat site assessments (Action 1.3).

The network of conservation areas will include small, large, and intermediate-sized reserves. Large reserves are preferred because they minimize per-acre management costs, make it possible to preserve historic management regimes, where appropriate, for listed and special status species, reduce edge effect, and increase the likelihood of survival for their resident species by maintaining more ecosystem functions. However, small reserves also can contribute to recovery. Often, these small areas are all that remain of formerly large vernal pool ecosystems and represent unique

genotypes or ecological conditions. Results of research into habitat needs described in Action 4 will help determine minimum reserve size and optimal buffer size.

Much of the natural land that contains species covered in this recovery plan needs to be protected in perpetuity. Protection in perpetuity of these lands includes the amelioration or elimination of the threats in perpetuity, and application of appropriate and adaptive management to ensure species survival and recovery. In other cases, there may be lands that can contribute to the recovery or long-term conservation of vernal pool species that do not need protection in perpetuity. For example, Safe Harbor Agreements can provide private and non-Federal property owners incentives to restore, enhance, and maintain habitats for listed species by providing assurances that specified activities will not be constrained and result in Endangered Species Act restrictions. Net conservation benefits from these voluntary agreements can establish or maintain connectivity between listed species' populations, can buffer existing populations, or can provide other net conservation benefits. Please see Appendix F for further discussion of Safe Harbor Agreements.

Zone rankings for habitat protection in each core area are summarized in **Table IV-2** below. Appendix F describes numerous tools available to assist in the protection of habitat for vernal pool species.

1.4.1 Ensure Federal agencies managing land use their authorities to protect habitat and promote the recovery and conservation of the species addressed in this recovery plan.

For example, Federal agencies can enter into cooperative partnerships, ensure adequate management plans are developed and implemented, develop conservation programs through sections 7(a)(1) and 10(a), and minimize and avoid habitat loss through section 7(a)(2) consultations and section 10(a) habitat conservation plans. When possible, Federal agencies should ensure that easements and agreements allow periodic site visits by Federal, State, and local agencies on protected lands to assess preserve condition and conduct status surveys and research.

Table IV-2. Core areas for recovery of vernal pool plants and animals, organized by vernal pool region, species within each core area, and the zone ranking of each core area (Zone 1, 2 or 3).

Core Area Name	County	Listed Taxa --- Taxa of Concern	Comments	Zone[1]
CARRIZO VERNAL POOL REGION				
North and South Carrizo Plain (2 areas)	San Luis Obispo	longhorn fairy shrimp vernal pool fairy shrimp[2] --- western spadefoot toad	Includes the National Monument and State and private lands. *Myosurus minimus* var. *apus* last reported in 1952. Reintroduction may be necessary.	2
Paso Robles (1 area)	San Luis Obispo, Monterey	vernal pool fairy shrimp[2] --- western spadefoot toad		2
Central Coastal Ranges (2 areas)	San Luis Obispo, Monterey	vernal pool fairy shrimp[2] --- western spadefoot toad	Includes Camp Roberts, Paso Robles.	2
CENTRAL COAST VERNAL POOL REGION				
Coal Mine Ridge (1 area)	San Mateo, Santa Clara	no listed taxa covered in this recovery plan --- *Legenere limosa*	Historical locality. Population last reported in 1906. Reintroduction may be necessary if status surveys indicate need.	3
Fort Ord (1 area)	Monterey	*Lasthenia conjugens* --- California fairy shrimp		2
San Benito (1 area)	San Benito Monterey	vernal pool fairy shrimp[2] --- western spadefoot toad		2

Core Area Name	County	Listed Taxa --- Taxa of Concern	Comments	Zone[1]
Fort Hunter-Liggett (1 area)	Monterey	vernal pool fairy shrimp[2] --- western spadefoot toad		2
Southeastern San Francisco Bay (1 area)	Alameda	*Lasthenia conjugens* vernal pool tadpole shrimp --- *Astragalus tener* var. *tener*		2
KLAMATH MOUNTAINS VERNAL POOL REGION				
Agate Desert (9 areas)	Jackson (Oregon)	vernal pool fairy shrimp[2]		2
Table Rocks (2 areas)	Jackson (Oregon)	vernal pool fairy shrimp[2]		2
White City (11 areas)	Jackson (Oregon)	vernal pool fairy shrimp[2]		2
LAKE-NAPA VERNAL POOL REGION				
Berryessa (1 area)	Napa	*Lasthenia conjugens* *Navarretia leucocephala* ssp. *pauciflora*	Includes Mead Ranch, Milliken Canyon.	2
Boggs Lake-Clear Lake (7 areas)	Lake	*Eryngium constancei* *Navarretia leucocephala* ssp. *pauciflora* *Navarretia leucocephala* ssp. *plieantha* *Orcuttia tenuis* *Parvisedum leiocarpum* --- *Gratiola heterosepala* *Legenere limosa*	Includes Boggs Lake Preserve, Cobb, Little High Valley, Loch Lomond Ecological Reserve, Manning Flat, Seigler Springs, Snows Lake, Stienhart Lakes, Whispering Pines. Priority 1 due to presence of several highly restricted species.	1

Core Area Name	County	Listed Taxa --- Taxa of Concern	Comments	Zone[1]
Diamond Mountain (1 area)	Sonoma	*Eryngium constancei*	Priority 1 due to presence of *Eryngium constancei*.	1
Dry Lake (1 area)	Lake	*Eryngium constancei* *Navarretia leucocephala* ssp. *pauciflora*	Priority 1 due to presence of *Eryngium constancei* and *Navarretia leucocephala* ssp. *pauciflora*	1
Jordan Park (1 area)	Lake	*Navarretia leucocephala* ssp. *pauciflora*	Historical locality. Population last reported in 1932. Reintroduction may be necessary.	3
Long Valley (1 area)	Lake	no listed taxa covered in this recovery plan --- *Navarretia myersii* ssp. *deminuta*	Priority 1 because only known locality for this taxon.	1
Napa River (2 areas)	Napa	*Lasthenia conjugens* vernal pool fairy shrimp[2] --- *Legenere limosa*	Includes Fagan Marsh Ecological Area, Napa-Sonoma Marshes Wildlife Area, Suscol Ridge, and private lands.	2
LIVERMORE VERNAL POOL REGION				
Altamont Hills (5 areas)	Alameda Contra Costa	*Lasthenia conjugens* longhorn fairy shrimp vernal pool fairy shrimp[2] --- *Astragalus tener* var. *tener* *Eryngium spinosepalum* midvalley fairy shrimp	Includes Altamont Hills and Byron Hot Springs area. Historical locality. *Lasthenia conjugens* last reported in 1884. *Astragalus tener* var. *tener* last reported in 1957. *Eryngium spinosepalum* last reported in 1937. Reintroduction may be necessary.	1
MENDOCINO VERNAL POOL REGION				

Core Area Name	County	Listed Taxa ---------- Taxa of Concern	Comments	Zone[1]
Manchester (1 area)	Mendocino	*Lasthenia conjugens*	Historical locality. Population last reported in 1937. Reintroduction may be necessary.	3
MODOC PLATEAU VERNAL POOL REGION				
Northern Modoc Plateau (2 areas)	Modoc	*Orcuttia tenuis* ---------- *Gratiola heterosepala*	Vernal pool region includes the occurrence of *Gratiola heterosepala* in Lake County, Oregon.	2
Western Modoc Plateau (6 areas)	Modoc Siskiyou Shasta	*Orcuttia tenuis* *Tuctoria greenei* ---------- *Gratiola heterosepala*		2
Southwestern Modoc Plateau (5 areas)	Lassen Shasta	*Orcuttia tenuis* ---------- *Gratiola heterosepala*		2
Southern Modoc Plateau (1 area)	Plumas	*Orcuttia tenuis*		2
NORTHEASTERN SACRAMENTO VALLEY VERNAL POOL REGION				
Chico (1 area)	Butte	*Limnanthes floccosa* ssp. *californica* vernal pool fairy shrimp[2] vernal pool tadpole shrimp _____ California fairy shrimp western spadefoot toad	Priority 1 because center of concentration for *Limnanthes floccosa* ssp. *californica*.	1

Core Area Name	County	Listed Taxa --- Taxa of Concern	Comments	Zone[1]
Dales (1 area)	Shasta Tehama	*Orcuttia tenuis* vernal pool tadpole shrimp --- *Gratiola heterosepala* *Legenere limosa* California fairy shrimp	Includes Dales Lake Ecological Reserve, Battle Creek Wildlife Area, Table Mountain, Table Mountain Lake, and other private lands.	2
Doe Mill (1 area)	Butte	*Limnanthes floccosa* ssp. *californica* vernal pool fairy shrimp[2] vernal pool tadpole shrimp	Priority 1 because area of concentration for *Limnanthes floccosa* ssp. *californica*.	1
Honcut (2 areas)	Butte, Yuba	no listed taxa covered in this recovery plan --- *Juncus leiospermus* var. *ahartii*		2
Oroville (1 area)	Butte	*Chamaesyce hooveri* *Limnanthes floccosa* ssp. *californica* *Orcuttia pilosa* *Tuctoria greenei* California fairy shrimp vernal pool fairy shrimp[2] vernal pool tadpole shrimp	Includes Shippee area. Priority 1 because area of concentration for *Limnanthes floccosa* ssp. *californica*.	1
Palermo (1 area)	Butte	*Orcuttia tenuis*	Between Honcut and Richvale core areas.	2
Richvale (1 area)	Butte	*Tuctoria greenei*		2
Llano Seco (1 area)	Butte	vernal pool fairy shrimp[2] vernal pool tadpole shrimp --- *Astragalus tener* var. *ferrisiae*	Priority 1 due to presence of *Astragalus tener* var. *ferrisiae*.	1

Core Area Name	County	Listed Taxa --- Taxa of Concern	Comments	Zone[1]
Upper Butte Basin (1 area)	Butte	*Astragalus tener* var. *ferrisiae*	Priority 1 due to presence of *Astragalus tener* var. *ferrisiae*.	1
Vina Plains (1 area)	Butte Tehama	*Chamaesyce hooveri* *Limnanthes floccosa* ssp. *californica* *Orcuttia pilosa* *Orcuttia tenuis* *Tuctoria greenei* Conservancy fairy shrimp vernal pool fairy shrimp[2] vernal pool tadpole shrimp --- *Gratiola heterosepala* California fairy shrimp	Priority 1 due to presence of Conservancy fairy shrimp and *Limnanthes floccosa* ssp. *californica*. Includes Rock Creek.	1
NORTHWESTERN SACRAMENTO VALLEY VERNAL POOL REGION				
Black Butte (1 area)	Tehama	no listed taxa covered in this recovery plan --- *Gratiola heterosepala* *Legenere limosa*	Between Orland and Red Bluff core areas.	2
Millville Plains (1 area)	Shasta	*Orcuttia tenuis*	East of Redding and Stillwater Plains areas.	2
Orland (1 area)	Tehama	vernal pool fairy shrimp[2]		2
Red Bluff (1 area)	Tehama	vernal pool fairy shrimp[2] vernal pool tadpole shrimp --- *Gratiola heterosepala* *Legenere limosa* California fairy shrimp	Includes Thomes Creek Ecological Reserve and private lands.	2

Core Area Name	County	Listed Taxa --- Taxa of Concern	Comments	Zone[1]
Redding (3 areas)	Shasta	*Orcuttia tenuis* vernal pool fairy shrimp[2] vernal pool tadpole shrimp --- *Legenere limosa* California fairy shrimp	Includes Stillwater Plain area.	2
SAN JOAQUIN VALLEY VERNAL POOL REGION				
Caswell (1 area)	Stanislaus	Conservancy fairy shrimp vernal pool fairy shrimp[2] --- California fairy shrimp	Includes San Joaquin River National Wildlife Refuge. *Myosurus minimus* var. *apus* last reported in 1952. Reintroduction may be necessary. Priority 1 due to presence of Conservancy fairy shrimp.	1
Grassland Ecological (13 areas)	Merced	*Chamaesyce hooveri* *Neostapfia colusana* Conservancy fairy shrimp longhorn fairy shrimp vernal pool fairy shrimp[2] vernal pool tadpole shrimp --- *Astragalus tener* var. *tener* *Atriplex persistens* midvalley fairy shrimp California fairy shrimp western spadefoot toad	Includes Kesterson, San Luis, and Merced National Wildlife Refuges; Great Valley Grasslands State Park; and private lands. *Myosurus minimus* var. *apus* last reported in 1952. Reintroduction may be necessary. Priority 1 due to presence of Conservancy fairy shrimp, longhorn fairy shrimp, and high number of species.	1
Pixley (2 areas)	Tulare	vernal pool fairy shrimp[2] --- western spadefoot toad	Includes Pixley National Wildlife Refuge and Pixley Vernal Pools Preserve.	2

Core Area Name	County	Listed Taxa --- Taxa of Concern	Comments	Zone[1]
Cross Creek (1 area)	Tulare, Kings	vernal pool fairy shrimp[2] vernal pool tadpole shrimp --- western spadefoot toad		2
SANTA BARBARA VERNAL POOL REGION				
Lake Cachuma (1 area)	Santa Barbara	vernal pool fairy shrimp[2]		2
Ventura County (1 area)	Ventura	Conservancy fairy shrimp vernal pool fairy shrimp[2]	In Los Padres National Forest.	2
SOLANO-COLUSA VERNAL POOL REGION				
Collinsville (1 area)	Solano	Conservancy fairy shrimp vernal pool tadpole shrimp --- *Astragalus tener* var. *tener*	Priority 1 due to presence of Conservancy fairy shrimp.	1
Davis Communications Annex (1 area)	Yolo	*Neostapfia colusana* *Tuctoria mucronata* vernal pool tadpole shrimp --- *Astragalus tener* var. *tener*	Priority 1 due to presence of one of two known extant locations of *Tuctoria mucronata*. Largest occurrence of *Tuctoria mucronata*.	1
Dolan (2 areas)	Colusa	vernal pool tadpole shrimp --- *Astragalus tener* var. *ferrisiae*		2

Core Area Name	County	Listed Taxa --- Taxa of Concern	Comments	Zone[1]
Jepson Prairie (1 area)	Solano	*Neostapfia colusana* *Lasthenia conjugens* *Tuctoria mucronata* delta green ground beetle Conservancy fairy shrimp vernal pool fairy shrimp[2] vernal pool tadpole shrimp --- *Astragalus tener* var. *tener* *Atriplex persistens* *Gratiola heterosepala* *Legenere limosa* midvalley fairy shrimp California fairy shrimp	Includes Jepson Prairie Preserve, Calhoun Cut Ecological Reserve, Glide Tule Ranch, parts of Travis Air Force Base, and other public and private lands. Priority 1 due to presence of delta green ground beetle, *Tuctoria mucronata*, Conservancy fairy shrimp, and high number of species in the area.	1
Montezuma Hills (1 area)	Solano	no listed taxa covered in this recovery plan --- *Plagiobothrys hystriculus*	Priority 1 due to presence of only known location of *Plagiobothrys hystriculus*.	1
Rodeo Creek (1 area)	Contra Costa	*Lasthenia conjugens*		2
Sacramento National Wildlife Refuge (11 areas)	Colusa Glenn	*Chamaesyce hooveri* *Orcuttia pilosa* *Tuctoria greenei* Conservancy fairy shrimp vernal pool fairy shrimp[2] vernal pool tadpole shrimp --- *Astragalus tener* var. *ferrisiae* *Atriplex persistens*	Includes nearby private lands. Priority 1 due to the presence of Conservancy fairy shrimp and *Astragalus tener* var. *ferrisiae*.	1

Core Area Name	County	Listed Taxa --- Taxa of Concern	Comments	Zone[1]
Suisun Marsh (2 areas)	Solano	*Lasthenia conjugens* --- *Astragalus tener* var. *tener*		2
Vacaville (1 area)	Solano	vernal pool fairy shrimp[2]		2
Woodland (1 area)	Yolo	no listed taxa covered in this recovery plan --- *Astragalus tener* var. *tener*		2
SOUTHEASTERN SACRAMENTO VERNAL POOL REGION				
Beale (1 area)	Yuba	vernal pool fairy shrimp[2] vernal pool tadpole shrimp --- California fairy shrimp *Legenere limosa*	Includes Beale Air Force Base, Bureau of Land Management, and private lands.	2
Cosumnes/Rancho Seco (1 area)	Sacramento, Amador	*Orcuttia viscida* vernal pool fairy shrimp[2] vernal pool tadpole shrimp --- *Legenere limosa* California fairy shrimp midvalley fairy shrimp western spadefoot toad	Includes Cosumnes River Preserve, Rancho Seco, Howard Ranch, Valensin Ranch, Clay Station mitigation bank, Borden Ranch mitigation site, and other private lands. Priority 1 due to presence of *Orcuttia viscida*.	1
Jenny Lind (1 area)	Calaveras	no listed taxa covered in this recovery plan --- *Juncus leiospermus* var. *ahartii*		2

Core Area Name	County	Listed Taxa --- Taxa of Concern	Comments	Zone[1]
Mather (1 area)	Sacramento	*Orcuttia tenuis* *Orcuttia viscida* vernal pool fairy shrimp[2] vernal pool tadpole shrimp --- *Gratiola heterosepala* *Juncus leiospermus* var. *ahartii* *Legenere limosa* midvalley fairy shrimp California fairy shrimp western spadefoot toad	Includes Mather Regional Park, the former Mather Air Force Base, Sunrise Douglas Conservation Bank, Arroyo Seco Conservation Bank, Churchill Downs mitigation area, Teichert mitigation area, and private lands Priority 1 due to presence of *Orcuttia viscida* and high number of rare species in the area.	1
Phoenix Field and Phoenix Park (1 area)	Sacramento	*Orcuttia viscida* --- California fairy shrimp western spadefoot toad	Priority 1 due to presence of *Orcuttia viscida*.	1
Southeast Sacramento Valley (1 area)	San Joaquin	*Castilleja campestris* ssp. *succulenta*	Includes University of California Angraves Nature Study Area.	2
Stone Lake (1 area)	Sacramento	no listed taxa covered in this recovery plan --- *Legenere limosa*		2

Core Area Name	County	Listed Taxa --- Taxa of Concern	Comments	Zone[1]
Western Placer County (2 areas)	Placer, Sacramento	vernal pool fairy shrimp[2] vernal pool tadpole shrimp --- *Gratiola heterosepala* *Juncus leiospermus* var. *ahartii* *Legenere limosa* California fairy shrimp western spadefoot toad	Includes Ahart Preserve, Orchard Creek Conservation Bank, and private lands.	2
SOUTHERN SIERRA FOOTHILLS VERNAL POOL REGION				
Farmington (1 area)	Stanislaus, Tuolumne	*Neostapfia colusana* *Tuctoria greenei* --- western spadefoot toad	Historical locality for *Tuctoria greenei*; population last reported in 1936. Reintroduction may be necessary.	2
Fresno (3 areas)	Fresno	*Castilleja campestris* ssp. *succulenta* *Tuctoria greenei* *Orcuttia inaequalis* vernal pool fairy shrimp[2] --- *Eryngium spinosepalum* midvalley fairy shrimp California fairy shrimp western spadefoot toad		2
San Joaquin (1 area)	San Joaquin, Stanislaus	vernal pool fairy shrimp[2] --- western spadefoot toad		2

Core Area Name	County	Listed Taxa --- Taxa of Concern	Comments	Zone[1]
Kaweah (2 areas)	Tulare	no listed taxa covered in this recovery plan --- *Eryngium spinosepalum*		2
Kings (3 areas)	Fresno Tulare	no listed taxa covered in this recovery plan --- *Eryngium spinosepalum*		2
Madera (7 areas)	Merced, Madera, Mariposa	*Castilleja campestris* ssp. *succulenta* *Neostapfia colusana* *Orcuttia inaequalis* *Orcuttia pilosa* *Tuctoria greenei* Conservancy fairy shrimp vernal pool fairy shrimp[2] vernal pool tadpole shrimp --- *Gratiola heterosepala* *Eryngium spinosepalum* California fairy shrimp midvalley fairy shrimp western spadefoot toad	Priority 1 due to presence of Conservancy fairy shrimp and high number of rare species in the area	1

Core Area Name	County	Listed Taxa ---------- Taxa of Concern	Comments	Zone[1]
Merced (2 areas)	Stanislaus, Tuolumne	*Castilleja campestris* ssp. *succulenta* *Chamaesyce hooveri* *Neostapfia colusana* *Tuctoria greenei* *Orcuttia pilosa* vernal pool fairy shrimp[2] vernal pool tadpole shrimp ---------- California fairy shrimp western spadefoot toad	Priority 1 due to presence of *Castilleja campestris* ssp. *succulenta* and high number of rare species in the area.	1
Shotgun Creek (1 area)	Tuolumne Calaveras	no listed taxa covered in this recovery plan ---------- *Eryngium spinosepalum*		2
Table Mountain (2 areas)	Fresno Madera	*Castilleja campestris* ssp. *succulenta* *Orcuttia inaequalis* vernal pool fairy shrimp[2] vernal pool tadpole shrimp ---------- *Gratiola heterosepala* *Eryngium spinosepalum* California fairy shrimp	Includes Big Table and Kennedy Table. Priority 1 due to presence of *Castilleja campestris* ssp. *succulenta* and high number of rare species in the area.	1
Tulare (2 areas)	Tulare	*Chamaesyce hooveri* *Orcuttia inaequalis* ---------- *Eryngium spinosepalum*	Includes Stone Corral and Sequoia Field Ecological Reserves, and Cross Creek area	2

Core Area Name	County	Listed Taxa --- Taxa of Concern	Comments	Zone[1]
Turlock (2 areas)	Stanislaus	vernal pool fairy shrimp[2] *Neostapfia colusana* *Orcuttia pilosa* *Chamaesyce hooveri*	Includes Hickman vernal pool complex.	2
Yokohl (2 areas)	Tulare	no listed taxa covered in this recovery plan --- *Eryngium spinosepalum*		2
Lake Success (1 area)	Tulare	no listed taxa covered in this recovery plan --- *Eryngium spinosepalum*		2
Cottonwood Creek (3 areas)	Tulare	*Chamaesyce hooveri* vernal pool fairy shrimp[2] vernal pool tadpole shrimp --- *Eryngium spinosepalum* western spadefoot toad		2
Waterford (1 area)	Stanislaus	*Neostapfia colusana* *Tuctoria greenei*		2
WESTERN RIVERSIDE COUNTY VERNAL POOL REGION				
Harford Springs (1 area)	Riverside	no listed taxa covered in this recovery plan --- *Myosurus minimus* var. *apus*	In the Riverside Management Area of the Recovery Plan for Vernal Pools of Southern California (U.S. Fish and Wildlife Service 1998b).	2
San Jacinto-Hemet (4 areas)	Riverside	vernal pool fairy shrimp[2] --- *Myosurus minimus* var. *apus* western spadefoot toad	In the Riverside Management Area of the Recovery Plan for Vernal Pools of Southern California (U.S. Fish and Wildlife Service 1998b).	2

Core Area Name	County	Listed Taxa --- Taxa of Concern	Comments	Zone[1]
Santa Rosa Plateau (1 area)	Riverside	vernal pool fairy shrimp[2] --- *Myosurus minimus* var. *apus*	In the Riverside Management Area of the Recovery Plan for Vernal Pools of Southern California (U.S. Fish and Wildlife Service 1998b).	2
Skunk Hollow (1 area)	Riverside	vernal pool fairy shrimp[2]		2
SAN DIEGO VERNAL POOL REGION				
Tierrasanta south (1 area)	San Diego	no listed taxa covered in this recovery plan --- *Myosurus minimus* var. *apus*	Includes Penasquitos and Tierrasanta areas. See Recovery Plan for Vernal Pools of Southern California (U.S. Fish and Wildlife Service 1998b).	2
Ramona (1 area)	San Diego	no listed taxa covered in this recovery plan --- *Myosurus minimus* var. *apus* western spadefoot toad	Includes Ramona area. See Recovery Plan for Vernal Pools of Southern California (U.S. Fish and Wildlife Service 1998b).	2
Otay Mesa (1 area)	San Diego	no listed taxa covered in this recovery plan --- *Myosurus minimus* var. *apus*	Includes Chula Vista, Otay Mesa, Marron Valley. See Recovery Plan for Vernal Pools of Southern California (U.S. Fish and Wildlife Service 1998b).	2

[1] Priority designations were assigned according to those species or localities representing the rarest species/genetics, most unique conditions, highest biodiversity, and greatest threat of destruction.

[2] Recovery criteria for vernal pool fairy shrimp, the widest ranging species in this plan, is protection of a total of 85 percent of suitable habitat species rangewide. This total amount of habitat must be represented to some degree in all core areas in which the species occurs. The rarity of the species with which it co-occurs does not affect this percentage. For all other species, the percentage of habitat protection for every species in any core area is equal to that of the rarest species found in that core area.

1.4.1.1 Protect species occurrences and suitable vernal pool habitat in Zone 1 core areas. (Priority 1)

Protection of Zone 1 core areas has been designated as a Priority 1 action because we believe that within each Zone 1 core area, protection of species occurrences and suitable vernal pool habitat is necessary to prevent extinction or irreversible decline of at least one species covered by this plan. As stated above in Section III.C.1.a, if sufficient species occurrences and suitable habitat of each species are protected in Zone 1 core areas throughout the range of each species, it is anticipated that some of the species covered by this plan may be recovered through the protection of Zone 1 core areas. Therefore, in addition to avoiding the extinction or irreversible decline of species covered by this plan, this action may meet the recovery and conservation objectives of the plan for certain species with regard to habitat protection. Several Zone 2 core areas are also considered Priority 1 with respect to specific species (*i.e.*, longhorn fairy shrimp in North and South Carrizo Plain, Conservancy fairy shrimp in the Los Padres National Forest, *Navarretia leucocephala* ssp. *pauciflora* in Berryessa, and various occurrences of *Lasthenia conjugens*).

1.4.1.2 Protect species occurrences and their vernal pool habitat in Zone 2 core areas. (Priority 2)

This action has been designated as Priority 2 because we believe that protection of species occurrences and suitable vernal pool habitat in Zone 2 core areas is necessary to prevent a significant decline in the species population or habitat quality or some other significant negative impact short of extinction for at least one species covered by this plan. Species that occur only in Zone 1 core areas are not affected by this action. For species that occur in Zone 2 core areas, protection of suitable

habitat and species occurrences under this action will contribute to recovery.

1.4.1.3 Protect species occurrences and their vernal pool habitat in Zone 3 core areas. (Priority 3)

As stated above in Section III.C.1.a, if habitat and species occurrence protection in Zone 1 and 2 core areas is not sufficient to recover or conserve the plan's covered species, habitat and species occurrences should be protected in Zone 3 core areas until sufficient suitable habitat and species occurrences have been protected.

1.4.1.4 Protect species occurrences and their vernal pool habitat that do not occur within a core area, but do occur within a vernal pool region. (Priority 3)

As stated above in Section III.C.1.a, if habitat and species occurrence protection in Zone 1, 2 and 3 core areas is not sufficient to recover or conserve the recovery plan's covered species, habitat and species occurrences should be protected within vernal pool regions until sufficient suitable habitat and species occurrences have been protected.

1.4.1.5 Protect all other species occurrences and their vernal pool habitat that do not occur within a vernal pool region, but do contribute to recovery and long-term conservation of species addressed in this recovery plan. (Priority 3)

If habitat and species occurrence protection in Zone 1, 2 and 3 core areas and vernal pool regions is not sufficient to recover or conserve the recovery plan's covered species, habitat and species occurrences elsewhere should be protected outside of vernal pool regions until sufficient suitable habitat and species occurrences have been protected.

1.4.2 Ensure State and local agencies managing land use their authorities to protect habitat and promote the recovery and conservation of the species addressed in this recovery plan.

For example, State and local agencies can enter into cooperative partnerships, ensure adequate management plans are developed and implemented, or develop conservation programs through the Natural Community Conservation Planning process. When possible, State and local agencies should ensure that easements and agreements allow periodic site visits by Federal, State, and local agencies on protected lands to assess preserve condition and conduct status surveys and research.

1.4.2.1 Protect species occurrences and their vernal pool habitat in Zone 1 core areas. (Priority 1)

1.4.2.2 Protect species occurrences and their vernal pool habitat in Zone 2 core areas. (Priority 2)

1.4.2.3 Protect species occurrences and their vernal pool habitat in Zone 3 core areas. (Priority 3)

1.4.2.4 Protect species occurrences and their vernal pool habitat that do not occur within a core area, but do occur within a vernal pool region. (Priority 3)

1.4.2.5 Protect all other species occurrences and their vernal pool habitat that does not occur within a vernal pool region, but do contribute to recovery and long-term conservation of species addressed in this recovery plan. (Priority 3)

1.4.3 Work with willing private landowners with current conservation easements to implement management measures or practices to protect vernal pool habitat and promote the recovery and conservation of the species addressed in this recovery plan.

For example, agencies or private entities responsible for overseeing existing conservation agreements can conduct periodic reviews of existing agreements, update agreements

as necessary, and conduct periodic site visits on private lands. When possible, agencies and private entities should ensure that easements and agreements allow periodic site visits by Federal, State, and local agencies on protected lands to assess preserve condition and conduct status surveys and research.

1.4.3.1 Protect species occurrences and their vernal pool habitat in Zone 1 core areas. (Priority 1)

1.4.3.2 Protect species occurrences and their vernal pool habitat in Zone 2 core areas. (Priority 2)

1.4.3.3 Protect species occurrences and their vernal pool habitat in Zone 3 core areas. (Priority 3)

1.4.3.4 Protect species occurrences and their vernal pool habitat that do not occur within a core area, but do occur within a vernal pool region. (Priority 3)

1.4.3.5 Protect all other species occurrences and their vernal pool habitat that does not occur within a vernal pool region, but do contribute to recovery and long-term conservation of species addressed in this recovery plan. (Priority 3)

1.4.4 As appropriate, protect habitat through acquisition of private land from willing sellers, new conservation agreements with willing private landowners, or other protection mechanisms (Appendix F) to promote the recovery and conservation of the species addressed in this recovery plan.

1.4.4.1 Protect species occurrences and their vernal pool habitat in Zone 1 core areas. (Priority 1)

1.4.4.2 Protect species occurrences and their vernal pool habitat in Zone 2 core areas. (Priority 2)

1.4.4.3 Protect species occurrences and their vernal pool habitat in Zone 3 core areas. (Priority 3)

1.4.4.4 Protect species occurrences and their vernal pool habitat that do not occur within a core area, but do occur within a vernal pool region. (Priority 3)

1.4.4.5 Protect all other species occurrences and their vernal pool habitat that does not occur within a vernal pool region, but do contribute to recovery and long-term conservation of species addressed in this recovery plan. (Priority 3)

2 Manage, restore, and monitor vernal pool habitat to promote the recovery of listed species and the long-term conservation of the species of concern.

Protecting vernal pool habitat from further destruction or fragmentation is merely the first step in the recovery strategy presented in this recovery plan. Following protection, the habitat must be managed and monitored to ensure the protected habitat is functioning properly and contributing to the recovery of the listed species and the long-term conservation of the species of concern. This management may include maintaining historical management regimes when appropriate for listed and special status species. In specific instances, it may be necessary to restore the habitat prior to being able to properly manage it for the benefit of vernal pool species.

2.1 Conduct interim habitat management to maintain, stabilize, or enhance ecosystem function and declining populations.

Each protected site will be subjected to threats that should be addressed while long-term, comprehensive habitat management plans are being compiled, reviewed, revised, and developed (Action 2.3), and additional research (Action 4) is underway; otherwise, the damage to these sites and the vernal pool biota present may be irreversible. In some cases, the appropriate interim habitat management is obvious and should be implemented. In other cases, scoping should begin to evaluate possible interim habitat management measures, their effectiveness, and their relative implementation costs. Stabilization may include managing habitat to enhance and/or restore vernal pool function; reintroducing seeds, vernal pool branchiopod cysts or mature individuals, pollinators or other symbionts; or other actions. If populations are enhanced by adding seeds, cysts, or mature individuals, only genotypes and ecotypes similar to the existing

population should be used (see Action 4.1.1). In some cases amplifying populations under laboratory conditions may be preferable.

2.1.1 Ensure Federal agencies managing land use their authorities to conduct interim management to promote the recovery of listed species and the long-term conservation of the species of concern addressed in this recovery plan.

2.1.1.1 Conduct interim management on lands in Zone 1 core areas. (Priority 1)

2.1.1.2 Conduct interim management on lands in Zone 2 core areas. (Priority 2)

2.1.1.3 Conduct interim management on lands in Zone 3 core areas. (Priority 3)

2.1.1.4 Conduct interim management on lands that do not occur in a core area, but do occur within a vernal pool region. (Priority 3)

2.1.1.5 Conduct interim management on lands that do not occur within a vernal pool region, but do contribute to recovery and long-term conservation of the species addressed in this recovery plan. (Priority 3)

2.1.2 Ensure State and local agencies managing land use their authorities to conduct interim management to promote the recovery of listed species and the long-term conservation of the species of concern addressed in this recovery plan.

2.1.2.1 Conduct interim management on lands in Zone 1 core areas. (Priority 1)

2.1.2.2 Conduct interim management on lands in Zone 2 core areas. (Priority 2)

2.1.2.3 Conduct interim management on lands in Zone 3 core areas. (Priority 3)

2.1.2.4 Conduct interim management on lands that do not occur in a core area, but do occur within a vernal pool region. (Priority 3)

2.1.2.5 Conduct interim management on lands that do not occur within a vernal pool region, but do contribute to recovery and long-term conservation of the species addressed in this recovery plan. (Priority 3)

2.1.3 Ensure private landowners with existing conservation agreements are conducting interim management to promote the recovery of listed species and long-term conservation of the species of concern addressed in this recovery plan.

2.1.3.1 Conduct interim management on lands in Zone 1 core areas. (Priority 1)

2.1.3.2 Conduct interim management on lands in Zone 2 core areas. (Priority 2)

2.1.3.3 Conduct interim management on lands in Zone 3 core areas. (Priority 3)

2.1.3.4 Conduct interim management on lands that do not occur in a core area, but do occur within a vernal pool region. (Priority 3)

2.1.3.5 Conduct interim management on lands that do not occur within a vernal pool region, but do contribute to recovery and long-term conservation of the species addressed in this recovery plan. (Priority 3)

2.2 Develop and implement standardized monitoring techniques to evaluate ecosystem function and response, species response, and threat response to interim management activities.

Standardized monitoring techniques need to be developed to ensure consistency and continuity of data between observers and over time. Standardized monitoring must be based on multiple criteria. No single criterion will reliably measure trends consistently over time. Standardized monitoring techniques should include criteria such as the degree of habitat fragmentation, degree

of threat, shifts in vegetation type, establishment and extirpation of plant and animal occurrences, number of individuals, photopoints, estimates of acreage occupied, density, co-occurring species including nonnatives, time since last disturbance, and some estimate of seedbank or cystbank dynamics.

Baseline conditions of habitat, species, and threats responsible for effects on ecosystem function and species decline must be documented prior to implementing changes to interim habitat management techniques.

2.2.1 Develop standardized monitoring techniques to evaluate ecosystem function and response, species response, and threat response to interim management activities. (Priority 2)

Per Action 2.1, conduct interim habitat management activities to maintain, stabilize, or enhance ecosystem function and declining populations during the development of standardized monitoring techniques.

2.2.2 Implement standardized monitoring to document ecosystem and species responses to interim habitat management activities. (Priority 2)

It may be necessary to modify interim habitat management activities according to monitoring results. This strategy is referred to as "adaptive" management and it is essential to the recovery and long-term conservation of vernal pool species as new information becomes available.

Castilleja campestris ssp. *succulenta*, *Chamaesyce hooveri*, *Lasthenia conjugens*, *Tuctoria mucronata*, *Neostapfia colusana*, *Tuctoria greenei*, *Astragalus tener* var. *ferrisiae*, *Astragalus tener* var. *tener*, *Navarretia leucocephala* ssp. *pauciflora*, and *Legenere limosa* require interim monitoring at 13 different locations (**Table IV-2**) because they are small populations and are the only representatives from a given vernal pool region or vernal pool type. Monitoring and subsequent protection of these populations prior to completion of other recovery actions for those species is

necessary to ensure the species distributions throughout their range.

2.3 Compile, review, develop, and implement existing long-term, comprehensive habitat management and monitoring plans, where necessary, for all land contributing to the recovery and long-term conservation of vernal pool species.

2.3.1 Compile, review, and analyze existing long-term, comprehensive habitat management and monitoring plans, or pertinent information from those plans, as necessary. (Priority 2)

Compiling existing habitat management and monitoring plans and/or pertinent information from those plans is essential for understanding what exists, what is relevant and useful, and what needs to be developed in the future. One alternative to actually compiling existing long-term, comprehensive habitat management and monitoring plans is to develop a standardized survey form with specific questions or requests for information about existing long-term, comprehensive habitat management and monitoring plans. These surveys can be sent to all land managers and the responses analyzed to determine gaps in plan development.

2.3.2 Where necessary, develop new, or improve existing, long-term, comprehensive habitat management and monitoring plans.

Long-term, comprehensive habitat management and monitoring plans are necessary to ensure that protected lands are managed to ameliorate and eliminate the threats that caused the species addressed in this recovery plan to become listed or species of concern. Long-term, comprehensive habitat management and monitoring plans should be developed and implemented to address habitat management activities (*e.g.*, prescriptions for control or removal of invasive species), existing threats (*e.g.*, habitat degradation due to inappropriate levels of recreational use), species and habitat responses to habitat management activities, incorporation of monitoring results into habitat

management plans, and schedule for the completion of operations and maintenance of ongoing routine tasks and one-time tasks.

The development of a long-term, comprehensive habitat management and monitoring plan is imperative. For example, military installations that have vernal pool conservation areas that are currently being managed and monitored, may not have permanent long-term conservation strategies in place. If an installation were subject to closure, there would be no guarantee that conservation of these areas would continue after the military presence departed the installation. A long-term, comprehensive habitat management and monitoring plan that included the use of conservation easements, for example, would ensure that these habitats are protected in perpetuity, regardless of the military presence at the installation.

Land managers should ensure that mechanisms (*e.g.*, funding, personnel, *etc.*) are not only in place, but are fully implemented to facilitate the development of long-term, comprehensive habitat management and monitoring plans.

Long-term, comprehensive habitat management and monitoring plans should be reviewed regularly and adjusted as necessary to maximize the potential for survival, conservation, and recovery of listed species and the species of concern addressed in this recovery plan. This process of evaluating and adjusting management and monitoring activities as needed is termed “adaptive management”. Results of new biological research also should be considered in adaptive management.

2.3.2.1 Ensure Federal agencies managing land use their authorities to develop new, or improve existing, long-term, comprehensive habitat management and monitoring plans to the benefit of species addressed in this recovery plan. (Priority 1)

2.3.2.2 Ensure State and local agencies managing land use their authorities to develop new, or improve

existing, long-term, comprehensive habitat management and monitoring plans to the benefit of species addressed in this recovery plan. (Priority 1)

2.3.2.3 Ensure private landowners with existing conservation agreements develop new, or improve existing, long-term, comprehensive habitat management and monitoring plans to the benefit of species addressed in this recovery plan. (Priority 1)

2.3.2.4 Ensure responsible parties of newly protected lands develop new, long-term, comprehensive habitat management and monitoring plans to the benefit of species addressed in this recovery plan. (Priority 1)

Provision should be made for agencies to visit protected lands to verify their condition.

2.3.3 Implement existing, and any newly developed or revised, long-term, comprehensive habitat management and monitoring plans.

2.3.3.1 Ensure Federal agencies managing land are implementing existing, and any newly developed or revised, long-term, comprehensive habitat management and monitoring plans to the fullest extent of their authorities.

2.3.3.1.1 Implement existing and any newly developed or revised, long-term comprehensive habitat management and monitoring plans on lands in Zone 1 core areas. (Priority 1)

2.3.3.1.2 Implement existing and any newly developed or revised, long-term comprehensive habitat management and monitoring plans on lands in Zone 2 core areas. (Priority 2)

2.3.3.1.3 Implement existing and any newly developed or revised, long-term

comprehensive habitat management and monitoring plans on lands in Zone 3 core areas. (Priority 3)

2.3.3.1.4 Implement existing and any newly developed or revised, long-term comprehensive habitat management and monitoring plans on lands that do not occur within a core area, but do occur within a vernal pool region. (Priority 3)

2.3.3.1.5 Implement existing and any newly developed or revised, long-term comprehensive habitat management and monitoring plans on lands that do not occur within a vernal pool region, but do contribute to recovery and long-term conservation of species addressed in this recovery plan. (Priority 3)

2.3.3.2 Ensure State and local agencies managing land are implementing existing, and any newly developed or revised, long-term, comprehensive habitat management and monitoring plans to the fullest extent of their authorities.

2.3.3.2.1 Implement existing and any newly developed or revised, long-term comprehensive habitat management and monitoring plans on lands in Zone 1 core areas. (Priority 1)

2.3.3.2.2 Implement existing and any newly developed or revised, long-term comprehensive habitat management and monitoring plans on lands in Zone 2 core areas. (Priority 2)

2.3.3.2.3 Implement existing and any newly developed or revised, long-term comprehensive habitat management and

monitoring plans on lands in Zone 3 core areas. (Priority 3)

2.3.3.2.4 Implement existing and any newly developed or revised, long-term comprehensive habitat management and monitoring plans on lands that do not occur within a core area, but do occur within a vernal pool region. (Priority 3)

2.3.3.2.5 Implement existing and any newly developed or revised, long-term comprehensive habitat management and monitoring plans on lands that do not occur within a vernal pool region, but do contribute to recovery and long-term conservation of species addressed in this recovery plan. (Priority 3)

2.3.3.3 Ensure private landowners with existing conservation agreements are implementing existing, and any newly developed or revised, long-term, comprehensive habitat management and monitoring plans to the fullest extent possible.

2.3.3.3.1 Implement existing and any newly developed or revised, long-term comprehensive habitat management and monitoring plans on lands in Zone 1 core areas. (Priority 1)

2.3.3.3.2 Implement existing and any newly developed or revised, long-term comprehensive habitat management and monitoring plans on lands in Zone 2 core areas. (Priority 2)

2.3.3.3.3 Implement existing and any newly developed or revised, long-term comprehensive habitat management and monitoring plans on lands in Zone 3 core areas. (Priority 3)

2.3.3.3.4 Implement existing and any newly developed or revised, long-term comprehensive habitat management and monitoring plans on lands that do not occur within a core area, but do occur within a vernal pool region. (Priority 3)

2.3.3.3.5 Implement existing and any newly developed or revised, long-term comprehensive habitat management and monitoring plans on lands that do not occur within a vernal pool region, but do contribute to recovery and long-term conservation of species addressed in this recovery plan. (Priority 3)

2.3.3.4 Ensure responsible parties of newly protected lands implement any newly developed long-term, comprehensive habitat management and monitoring plans to the benefit of species addressed in this recovery plan.

2.3.3.4.1 Implement existing and any newly developed or revised, long-term comprehensive habitat management and monitoring plans on lands in Zone 1 core areas. (Priority 1)

2.3.3.4.2 Implement existing and any newly developed or revised, long-term comprehensive habitat management and monitoring plans on lands in Zone 2 core areas. (Priority 2)

2.3.3.4.3 Implement existing and any newly developed or revised, long-term comprehensive habitat management and monitoring plans on lands in Zone 3 core areas. (Priority 3)

2.3.3.4.4 Implement existing and any newly developed or revised, long-term

comprehensive habitat management and monitoring plans on lands that do not occur within a core area, but do occur within a vernal pool region. (Priority 3)

2.3.3.4.5 Implement existing and any newly developed or revised, long-term comprehensive habitat management and monitoring plans on lands that do not occur within a vernal pool region, but do contribute to recovery and long-term conservation of species addressed in this recovery plan. (Priority 3)

2.4 Enhance, restore, and create vernal pool habitats, as necessary, to promote the recovery and long-term conservation of the species addressed in this recovery plan.

Enhancement, restoration, and creation of vernal pool habitat may be necessary when natural vernal pools representing certain ecological conditions have been degraded or destroyed. In all cases practicable, existing natural, undisturbed, high-quality pools should be used as a model for enhancement, restoration, and creation.

Vernal pools should only be created when enhancement and restoration activities are not sufficient, and where creation is ecologically appropriate. Pools should not be created within existing vernal pool landscapes because of the risk of disrupting hydrologic function and the surrounding upland habitat that is important to many vernal pool species.

2.4.1 Establish scientifically based, and site-specific appropriate, mechanisms and success criteria for the enhancement, restoration, and creation of vernal pool habitat.

Both the actual mechanisms and the success criteria for enhancement, restoration, and creation of vernal pool habitat may differ from one vernal pool region to another based on geographic, topographic and edaphic characteristics of the individual pools. However, they should be developed as uniformly as possible (*i.e.*,

standardized) to minimize ambiguity between regions. Also, mechanisms and success criteria should have both Federal and State interagency endorsement to ensure they are regionally applicable and accepted.

2.4.1.1 Review existing enhancement, restoration, and creation mechanisms and projects, success criteria, and degree to which projects have met success criteria. (Priority 3)

2.4.1.2 In coordination with us, develop scientifically based and site-specific appropriate mechanisms and success criteria based on review of existing mechanisms and the results of ecological research. (Priority 3)

2.4.2 Develop scientifically based, and site-specific appropriate, mechanisms and success criteria for the collection, storage, and use of soil containing shrimp cysts for the purpose of inoculating restored or created vernal pool habitat.

Both the actual mechanisms and the success criteria for collection, storage, and use of vernal pool soils containing shrimp cysts may differ from one vernal pool region to another based on topographic and edaphic characteristics of the individual pools and the biological needs of the target species. However, the mechanisms and success criteria should be developed as uniformly as possible (*i.e.*, standardized) to minimize ambiguity between regions. Also, mechanisms and success criteria should have both Federal and State interagency endorsement to ensure they are regionally applicable and accepted.

2.4.2.1 Review existing mechanisms of collection of soils bearing shrimp cysts, storage, and application and success criteria. (Priority 3)

2.4.2.2 In coordination with us, develop scientifically based and site-specific appropriate mechanisms and success criteria based on review of existing

mechanisms and the results of ecological research. (Priority 3)

2.4.3 Collect vernal pool soils bearing shrimp cysts.

2.4.3.1 In coordination with us, develop a prioritized list of sites from which shrimp cysts need to be collected to further the recovery and long-term conservation of vernal pool species. (Priority 3)

2.4.3.2 Implement introduction of cyst-bearing soils to restored or created habitat based on scientifically sound, and site-specific appropriate, mechanisms. (Priority 3)

2.4.3.3 Apply success criteria in a monitoring program to determine if cysts hatch and complete full life cycle of the shrimp over at least five seasons during a period of 10 years including one drought year. (Priority 3)

It may be necessary to modify cyst-bearing soil collection, storage, or application mechanisms and success criteria, as necessary, to achieve recovery and long-term conservation of the species addressed in this recovery plan. This "adaptive" approach is essential to the recovery and long-term conservation of vernal pool species as new information becomes available.

2.4.4 Enhance, restore, and/or create vernal pool habitat.

2.4.4.1 In coordination with the Sacramento Fish and Wildlife Office, develop a prioritized list of sites that need to be enhanced, restored, and/or created to further the recovery and long-term conservation of vernal pool species. (Priority 3)

2.4.4.2 In coordination with the Sacramento Fish and Wildlife Office, develop a prioritized list of which aspects of the vernal pool ecosystem function need

to be enhanced, restored, and/or created. (Priority 3)

For example, does a site need pools created, upland habitat or swale restoration, *etc.*

2.4.4.3 Implement vernal pool enhancement, restoration, and creation activities based on scientifically sound, and site-specific appropriate, mechanisms. (Priority 3)

2.4.4.4 Apply success criteria in a monitoring program to determine if species and ecosystem respond positively to the enhancement, restoration, and/or creation effort. (Priority 3)

It may be necessary to modify enhancement, restoration, and/or creation mechanisms and success criteria, as necessary, to achieve recovery and long-term conservation of the species addressed in this recovery plan. This "adaptive" approach is essential to the recovery and long-term conservation of vernal pool species as new information becomes available.

2.5 Develop and implement reintroduction and introduction programs to restore extirpated populations and protect individual species from the threat of extirpation due to random environmental and/or genetic events.

When necessary, species reintroductions and introductions have utility as part of a sound recovery strategy. Conservation of vernal pool plants and animals requires increasing their survival prospects, despite foreseeable events. Off-site or ex-situ methods can make the difference between survival and extinction, by preventing unique genotypes from disappearing altogether. While accession of seeds or cysts can be an important component of a comprehensive recovery strategy, it is by no means meant to replace conservation of populations in their natural habitat (in-situ). Ex-situ work is intended to support in-situ conservation. Collection, storage, and propagation of seeds and cysts should only be conducted as a last resort, where necessary to preserve rare or unique genotypes or occurrences in danger of extirpation from

stochastic events and only if all other methods of conservation have been insufficient.

Prior to undertaking reintroduction or introduction efforts for extirpated species, genetics studies should be conducted to ensure that new populations will not disrupt unique local gene complexes (Action 4.1.1). Plant reintroductions and introductions should be completed using locally collected seeds or plant propagules grown from locally collected seeds. Animal species reintroductions and introductions should follow the same general principal of protecting local genetic variation by using only local sources of species for stocking programs. In the case where reintroductions and introductions must be conducted using propagated individuals, our policy regarding controlled propagation (U.S. Fish and Wildlife Service 2000*b*) must be followed.

Reintroduction should only be conducted at sites from which the species has been extirpated from extant habitat. Introduction (to new localities) should only be done when previously occupied localities are no longer suitable and the species is adapted to the new location; thus, the introduction serves as a local "surrogate" population to the occurrence it is intended to replace.

2.5.1 Conduct seed collection and banking, as necessary, for plant species covered in this recovery plan.

Plant taxa for which seed banking is necessary are given in **Table IV-3**. Priority 1 is given to taxa known only from one or two locations. Priority 2 is given to the disjunct populations of plants that occur in more than two locations.

Table IV-3. Vernal pool plants that require seed collection and storage.

Species	Priority Number
Castilleja campestris ssp. *succulenta*[1]	2
Chamaesyce hooveri[1]: in Stanislaus and Tulare Counties all other locations	 1 2
Eryngium constancei [2]	1
Lasthenia conjugens [1]	2
Limnanthes floccosa ssp. *californica*[1]	2
Navarretia leucocephala ssp. *pauciflora* [2]	1
Navarretia leucocephala ssp. *plieantha* [2]	1
Orcuttia inaequalis[1]	2
Neostapfia colusana[1]: in Solano and Yolo Counties in all other locations	 1 2
Orcuttia pilosa[1]	2
Orcuttia tenuis[1]: in Sacramento County in all other locations	 1 2
Orcuttia viscida [2]	1
Parvisedum leiocarpum [2]	1
Tuctoria greenei [1]	2
Tuctoria mucronata [2]	1
Astragalus tener var. *ferrisiae* [2]	2
Astragalus tener var. *tener*[1]	2
Atriplex persistens[1]	2
Eryngium spinosepalum[1]	2
Gratiola heterosepala[1]	2
Juncus leiospermus var. *ahartii* [2]	2
Legenere limosa[1]	2
Myosurus minimus var. *apus*[1]	2
Navarretia myersii ssp. *deminuta* [3]	1
Plagiobothrys hystriculus [3]	1

[1] = One collection shall be conducted per core area.

[2] = Collections shall be made from all extant occurrences.

[3] = Collections shall be made from the single extant occurrence.

Initially, seeds should be banked from at least one population in each core area. For plant taxa with 10 extant occurrences or fewer, seeds should be banked from every known occurrence. After genetic studies are completed (Action 4.1.1), additional collections should be made from each population that contains unique genotypes. Repeated, small collections of seed may be necessary over several years to avoid contributing to the decline of very small populations. The Center for Plant Conservation (1991) detailed the considerations for seed collection in its "Genetic Sampling Guidelines for Conservation Collections of Endangered Plants." Seed collections from each population of each taxon should be stored in at least two sites, including the National Center for Genetic Resources Preservation in Fort Collins, Colorado, and a facility certified by the Center for Plant Conservation. State permitting requirements need to be followed for State listed species.

2.5.1.1 Review existing seed bank collections, as needed, to determine need to collect seeds and the number of seeds necessary. (Priority 1)

Seed collections for plant taxa should be representative of both population and species-level genetic diversity.

2.5.1.2 Conduct Priority 1 seed collection and banking as identified in **Table IV-3**. (Priority 1)

2.5.1.3 Conduct Priority 2 seed collection and banking as identified in **Table IV-3**. (Priority 2)

2.5.2 Conduct collection of soil containing cysts for use in inoculation of created or restored vernal pool habitat, as necessary, for shrimp species covered in this recovery plan.

Shrimp taxa for which cyst-bearing soil collection may be necessary are given in **Table IV-4**.

Initially, cyst-bearing soils should be collected from at least one population in each core area. For shrimp taxa with 10 extant occurrences or fewer, soils should be collected from

every known occurrence. After genetic studies are completed (Action 4.1.1), additional collections should be made from each population that contains unique genotypes.

2.5.2.1 Review history of collection of cyst-bearing soils, as needed, to determine need to collect cysts and the number of cysts necessary. (Priority 1)

Cyst collections for shrimp taxa should be representative of both population and species-level genetic diversity.

2.5.2.2 Conduct Priority 1 cyst-bearing soil collection as identified in **Table IV-4**, if necessary. (Priority 1)

2.5.2.3 Conduct Priority 2 cyst-bearing soil collection as identified in **Table IV-4**, if necessary. (Priority 2)

2.5.2.4 Conduct Priority 3 cyst-bearing soil collection as identified in **Table IV-4**, if necessary. (Priority 3)

Table IV-4. Vernal pool shrimp that require collection of cyst-bearing soils.

Species	Priority Number
Conservancy fairy shrimp	1
Longhorn fairy shrimp	1
Vernal pool fairy shrimp	2
Vernal pool tadpole shrimp	2
Midvalley fairy shrimp	2
California fairy shrimp	3

2.5.3 Conduct controlled propagation for reintroductions and/or introductions of plant species, as appropriate.

According to our policy (U.S. Fish and Wildlife Service 2000), a good controlled propagation plan will identify measurable objectives and milestones for the proposed propagation and reintroduction/introduction plan. The controlled propagation plan should be based on strategies identified in the approved recovery plan and in scientific literature, and include protocols for health management,

disease-free certification, monitoring and evaluation of genetic, demographic, life-history, phenotypic, and behavioral characteristics, data collection, recordkeeping, and reporting, as appropriate.

2.5.3.1 Prepare a controlled propagation plan for Priority 1 reintroductions and introductions indicated in **Table IV-5** and **Table IV-6**, respectively. (Priority 1)

2.5.3.2 Prepare a controlled propagation plan for Priority 2 reintroductions and introductions indicated in **Table IV-5** and **Table IV-6**, respectively. (Priority 2)

2.5.3.3 Prepare a controlled propagation plan for Priority 3 reintroductions and introductions indicated in **Table IV-5** and **Table IV-6**, respectively. (Priority 3)

2.5.3.4 If necessary, conduct germination trials for reintroductions and introductions. (Priority 3)

2.5.3.5 Propagate plants for Priority 1 reintroductions and introductions indicated in **Table IV-5** and **Table IV-6**, respectively. (Priority 1)

2.5.3.6 Propagate plants for Priority 2 reintroductions and introductions indicated in **Table IV-5** and **Table IV-6**, respectively. (Priority 2)

2.5.3.7 Propagate plants for Priority 3 reintroductions and introductions indicated in **Table IV-5** and **Table IV-6**, respectively. (Priority 3)

2.5.4 Reintroduce/introduce and monitor plant species at appropriate sites.

Preparation required prior to reintroduction/introduction work includes a thorough review of existing literature on reintroduction/introduction mechanisms and success criteria for plant species. If applicable information does not exist, scientifically based and site-specific reintroduction/introduction mechanisms and success

Table IV-5. Plant species for which reintroductions should be planned and implemented[1].

Species	Vernal Pool Region	Location	CNDDB Element Occurrence	Priority
Lasthenia conjugens	Lake-Napa	Milliken Canyon	#21	3
Neostapfia colusana	San Joaquin Valley	Arena Plains Unit of Merced NWR	#51, #52	3
Orcuttia viscida	SE Sacramento Valley	Orangevale-Folsom Rancho Seco	#4 #16	2
Tuctoria mucronata	Solano-Colusa	Olcott Lake	#1	1
Orcuttia pilosa	Southern Sierra Nevada	Stanislaus, Merced and Madera Counties	Many	2
Limnanthes floccosa ssp. *californica*	NE Sacramento Valley	Shippee Diesel	#6 #39	2
Navarretia leucocephala ssp. *pauciflora*	Lake-Napa	Jordan Park	#10	2

[1] See the Draft Santa Rosa Plains Recovery Plan (in development) for information regarding reintroduction of *Navarretia leucocephala* ssp. *plieantha* in the Santa Rosa area.

Table IV-6. Plant species for which introductions should be planned and implemented.

Species	Soils	Region	Replaces Element Occurrence #	Priority
Lasthenia conjugens	Haire loam	Lake-Napa Vernal Pool Region	2	3
	Linne clay loam	Livermore Vernal Pool Region	12	
	Crispin loam	Mendocino Vernal Pool Region	16	
	Concepcion fine sandy loam	Santa Barbara Vernal Pool Region	18	
	Los Osos complex	Need not be in a vernal pool region	10	
	Los Robles clay loam	Need not be in a vernal pool region	11	
	Rincon clay loam	Need not be in a vernal pool region	8	
Neostapfia colusana	NA	Colusa County portion of the Solano-Colusa Vernal Pool Region	13	3
	Bear Creek	Southern Sierra Foothills Vernal Pool Region	7 and 61	
Orcuttia inaequalis	Los Robles clay loam	Southern Sierra Foothills Vernal Pool Region	22	3
Tuctoria greenei	San Joaquin loam	Southern Sierra Foothills Vernal Pool Region	20	3
	San Joaquin sandy loam	Southern Sierra Foothills Vernal Pool Region	22	
	Archerdale clay loam	Southern Sierra Foothills Vernal Pool Region	8	
	Exeter sandy loam	Southern Sierra Foothills Vernal Pool Region	15	
	Ramona loam	Southern Sierra Foothills Vernal Pool Region	16 and 17	
Astragalus tener var. *ferrisiae*	Corning gravelly loam	Solano-Colusa Vernal Pool Region	5	3
	Westfan loam	Solano-Colusa Vernal Pool Region	9	

Species	Soils	Region	Replaces Element Occurrence #	Priority
Astragalus tener var. *tener*[1]	Antioch very fine sandy loam	Central Coast Vernal Pool Region	1	3
	Solano loam	Livermore Vernal Pool Region	9	
	Scribner	San Joaquin Valley Vernal Pool Region	10	
	Orthents	Need not be in a vernal pool region	19	
Navarretia myersii ssp. *deminuta*	appropriate soils	Lake County portion of the Lake-Napa Vernal Pool Region	NA	1
other plant taxa as necessary	appropriate soils	Any Region	NA	3

[1] See the Draft Santa Rosa Plains Recovery Plan (in development) for introduction of this species in the Santa Rosa area

criteria for plant species need to be developed, in coordination with the Sacramento Fish and Wildlife Office. These mechanisms and success criteria need to be based on a review of existing literature and the results of research.

2.5.4.1 Conduct Priority 1 reintroductions and introductions as indicated in **Table IV-5** and **Table IV-6**, respectively. (Priority 1)

2.5.4.2 Conduct Priority 2 reintroductions and introductions as indicated in **Table IV-5** and **Table IV-6**, respectively. (Priority 2)

2.5.4.3 Conduct Priority 3 reintroductions and introductions as indicated in **Table IV-5** and **Table IV-6**, respectively. (Priority 3)

2.5.4.4 Monitor Priority 1 reintroductions and/or introductions. (Priority 1)

2.5.4.5 Monitor Priority 2 reintroductions and/or introductions. (Priority 2)

2.5.4.6 Monitor Priority 3 reintroductions and/or introductions. (Priority 3)

2.5.4.7 Apply success criteria to reintroductions and/or introductions and modify techniques as necessary to achieve recovery and long-term conservation of vernal pool species. (Priority 3)

2.5.5 Reintroduce/introduce and monitor shrimp species at appropriate sites.

Preparation required prior to reintroduction/introduction work includes a thorough review of existing literature on reintroduction/introduction mechanisms and success criteria for shrimp species. If applicable information does not exist, scientifically based and site-specific reintroduction/introduction mechanisms and success criteria for shrimp species need to be developed, in coordination with the Sacramento Fish and Wildlife Office. These mechanisms and success criteria need to be based on a review of existing literature and the results of research.

2.5.5.1 Determine appropriate locations for reintroduction/introduction of the shrimp species covered in this plan. (Priority 1)

2.5.5.2 Conduct Priority 1 reintroductions and introductions as indicated in **Table IV-4**. (Priority 1)

2.5.5.3 Conduct Priority 2 reintroductions and introductions as indicated in **Table IV-4**. (Priority 2)

2.5.5.4 Conduct Priority 3 reintroductions and introductions as indicated in **Table IV-4**. (Priority 3)

2.5.5.5 Monitor Priority 1 reintroductions and/or introductions. (Priority 1)

2.5.5.6 Monitor Priority 2 reintroductions and/or introductions. (Priority 2)

2.5.5.7 Monitor Priority 3 reintroductions and/or introductions. (Priority 3)

2.5.5.8 Apply success criteria to reintroductions and/or introductions and modify techniques as necessary to achieve recovery and long-term conservation of vernal pool species. (Priority 3)

2.5.6 Reintroduce and monitor delta green ground beetle at appropriate sites.

2.5.6.1 Reintroduce delta green ground beetle to appropriate sites (*i.e.*, historical locations that are likely to support populations). (Priority 2)

Reintroduction of delta green ground beetle entails identification of and procurement of appropriate reintroduction sites, determination of need for symbionts, and determination of ecologically and genetically appropriate source material.

2.5.6.2 Monitor delta green ground beetle reintroductions. (Priority 2)

2.5.6.3 Apply success criteria to reintroductions and modify techniques as necessary to achieve recovery and long-term conservation of the delta green ground beetle (Priority 3).

3. Conduct range-wide status surveys and status reviews for all species addressed in this recovery plan to determine species status and progress toward achieving recovery of listed species and long-term conservation of species of concern.

A status survey is a detailed process comprising a literature review, and examination of herbarium or museum specimens, and a series of surveys conducted throughout a species' range. All historical localities of a species are identified, potential locations where the species may occur are predicted based on distributional and ecological data, all historical and

potential locations are surveyed for presence of a species at the appropriate time of year, all known and newly identified locations are surveyed to determine species population sizes and status of threats, and recommendations for improving conservation efforts are made for each locality.

Information from status surveys would be used to conduct status reviews (*e.g.*, 5-year reviews, candidate species reviews) to determine whether a species has met its recovery criteria and warrants downlisting or delisting, or in the case of a species of concern, warrants listing.

3.1 Develop standardized, species-specific guidance for conducting range-wide status surveys for all species addressed in this recovery plan.

Where possible, suites of species should be combined within the same guidance (*e.g.*, vernal pool branchiopods, spring flowering plant species, summer flowering plant species, *etc*.).

A standardized, scientifically based methodology should be developed to conduct range-wide status surveys for each species. It is important to use a standardized methodology to ensure consistency and continuity of data between observers, between vernal pool regions, and over time. Standardized status surveys should establish parameters that 1) evaluate population sizes to determine overall trends in species statuses rangewide (*e.g.*, populations stable or increasing), 2) evaluate presence of a species at a historical location or a potential location, 3) evaluate type and degree of existing, and newly identified, site-specific threats to species throughout a significant portion of their range, and 4) collect additional data, as necessary, on species occurrences throughout their range. Standardized surveys must be based on multiple parameters as no single parameter will reliably measure trends consistently over time. Standardized surveys may measure parameters such as the degree of habitat loss or fragmentation, type and degree of threat, shifts in vegetation type, establishment and extirpation of plant and animal occurrences, number of individuals or populations, photopoints, estimates of acreage occupied, density, co-occurring species including nonnatives, time since last disturbance, and some estimate of seedbank or cystbank dynamics for plant or shrimp species (is seedbank stable, depleted, being replenished, *etc.*).

3.1.1 Review existing species survey guidance to determine whether such guidance is adequate. (Priority 1)

3.1.2 If necessary, revise existing guidance or develop new standardized, scientifically based, and species-specific survey guidance. (Priority 1)

3.2 Conduct directed species status surveys.

Status surveys should be conducted at the vernal pool region scale, starting within core areas and working outward to the vernal pool region boundary. Populations within a vernal pool region cannot be reclassified or delisted independently, therefore, status surveys at the vernal pool region scale ensure all vernal pool regions meet the criteria prior to proposing a reclassification or delisting.

3.2.1 Identify and prioritize areas within each vernal pool region, starting with core areas, to conduct standardized status surveys. (Priority 1)

The subset of sites to be surveyed must contribute to a status survey adequate to assess whether a species is stable or declining.

Areas to be surveyed within vernal pool regions that contribute to the recovery of a species should be determined based on the following parameters: 1) core areas; 2) known and newly identified localities of each species within each vernal pool region; 3) historic localities of each species within each vernal pool region; 4) potential habitat locations identified through implementation of Action 1.2; 5) species statuses within each vernal pool region (*e.g.*, surveying a subset of localities for wide-ranging species versus all known localities for narrowly distributed species); 6) recovery criteria/goals for each species, and 7) standardized survey guidance as developed above in Action 3.1.

Recovery of listed species and long-term conservation of the species of concern addressed in this recovery plan may often require relocating historic populations or locating new populations of these species in potential habitat. Historical locations should be surveyed to determine

whether suitable habitat remains, the species persists at the sites, and/or the sites may be suitable for repatriation. Suitability of historical locations for repatriation would depend upon (1) whether potential habitat exists, (2) the presence and magnitude of threats, (3) whether the sites can be secured and managed for the long-term protection of the species and, (4) whether repatriation of the site is necessary to maintain genetic or geographic diversity and/or increase connectivity between larger protected areas. Surveys should also include other potential habitat to determine whether undiscovered populations may exist. If new populations are discovered, they need to be protected and managed as discussed above. During the surveys, potential introduction sites should also be identified.

3.2.2 Conduct standardized status surveys within each vernal pool region, starting with core areas. (Priority 1)

This action is linked to Action 1.3 so it should be completed and implemented concurrently.

3.3 Periodically review progress toward listed species recovery and long-term conservation of species of concern and identify those species warranting a change in status (downlisting, delisting, uplisting, or listing).

These reviews should be based on results of standardized status surveys and other information from research, habitat protection, management, and monitoring actions.

3.3.1 Compile most recent status reviews, or comparable evaluations, for each species and develop a prioritized list for status reviews of the species addressed in this recovery plan. (Priority 2)

3.3.2 Conduct status reviews of listed species by vernal pool region. (Priority 2)

3.3.3 Conduct status reviews of species of concern by vernal pool region. (Priority 3)

3.4 Conduct post-delisting monitoring of recovered species.

4 Conduct research and use results to refine recovery actions and criteria, and guide overall recovery and long-term conservation efforts.

4.1 Conduct research on species addressed in this recovery plan.

4.1.1 Conduct research on genetics necessary to make informed habitat protection and management decisions.

Priorities for genetics studies are as follows: 1) species that require reintroduction and/or introduction; 2) species that will require seed or cyst banking because of high risk of extirpations due to random events; 3) species/populations that have experienced extreme reductions in range and/or populations numbers that may now require genetic management to offset deleterious effects of genetic drift, bottlenecks and inbreeding depression, *etc.*

4.1.1.1 Conduct genetics analysis on species slated for reintroductions and introductions (*i.e.*, species requiring seed or cyst banking). (Priority 2)

Refer to **Tables IV-5 and IV-6** for a list of species we are recommending be reintroduced or introduced.

4.1.1.2 In coordination with us, compile and review existing information on genetic and population structure of remaining vernal pool species, and develop a prioritized list of species requiring additional genetics studies to assist in making management decisions. (Priority 3)

4.1.1.3 Conduct genetics analysis on remaining vernal pool species, as necessary. (Priority 2)

Consider other information that can indicate genetic structure, such as morphology, that could be used to inform management decisions without need to conduct additional genetic studies. Ensure all genetic studies are applicable to achieving recovery goals and objectives.

4.1.2 Conduct research on biosystematics.

Taxonomic research is not typically a recovery action, but the distribution of several taxa in this recovery plan is uncertain due to confusion over their identification and taxonomy. The lack of certainty concerning the distribution of several taxa of concern has precluded the possibility of listing under the Endangered Species Act. Some uncertainty also remains among listed taxa, particularly those for which populations intermediate in morphology are known. Biosystematic research, including DNA analysis, is needed for these taxa as a whole, or for specified populations, where noted.

4.1.2.1 *Limnanthes floccosa* ssp. *californica*. (Priority 2)

Determine if the historical populations at Nord (Element Occurrence #13) and 10 miles north of Chico (unnumbered) are actually this taxon.

4.1.2.2 *Navarretia leucocephala* spp. complex. (Priority 3)

4.1.2.3 *Astragalus tener* spp. complex. (Priority 3)

4.1.2.4 *Eryngium spinosepalum* spp. complex. (Priority 3)

4.1.2.5 *Myosurus minimus* var. *apus* complex. (Priority 3)

4.1.3 Conduct research on primary dispersal mechanism(s) for vernal pool plants and animals.

Existing data on the dispersal mechanisms of vernal pool species is limited, or in many cases, nonexistent. For a population to survive, individuals must pass their genes on to subsequent generations and colonize appropriate habitat. For plants, this entails dispersal of seeds and pollen. For vernal pool branchiopods this entails dispersing cysts. For species such as the western spadefoot toad, this involves juvenile and adult dispersal to and from breeding locations.

In the absence of data regarding dispersal mechanisms for vernal pool species, there is no appropriate manner to ensure

decisions about reserve size and location, habitat management activities, and corridor establishment between reserves function properly to provide for adequate gene flow to promote population viability. Since much of this information is unknown for a majority of the species covered in this recovery plan, we recommend the actions below.

Preparation required prior to dispersal mechanism research includes a thorough review of existing literature on dispersal mechanisms and distances for vernal pool species. Related species will need to be considered where information on listed species does not exist. Known dispersal mechanisms for some species may not be important in other species. For example, some plants are obligate self-fertilizers so gene flow is extremely low, some seeds do not lend themselves to any kind of dispersal mechanism, and dispersal may not be important for species with a very narrow range of environmental tolerances.

4.1.3.1 In coordination with us, and in conjunction with the priorities listed below for specific plant categories or species, develop a prioritized list, by species, of additional research needs on dispersal mechanisms. (Priority 2)

4.1.3.2 Implement research on plant dispersal mechanisms (see **Table IV-7** for life history categories of plants).

4.1.3.2.1 On annual herbs (Priority 2)

4.1.3.2.2 On annual grasses (Priority 2)

4.1.3.2.3 On biennial and perennial plants (Priority 2)

Table IV-7. Life history categories of vernal pool plants (see Action 4.1.3.2)

Action	Species	Comments
4.1.3.2.1	Annual herb	*Castilleja campestris* ssp. *succulenta*, *Chamaesyce hooveri*, *Lasthenia conjugens*, *Limnanthes floccosa* ssp. *californica*, *Navarretia leucocephala* ssp. *pauciflora* , *Navarretia leucocephala* ssp. *plieantha*, *Parvisedum leiocarpum*, *Astragalus tener* var. *ferrisiae*, *Astragalus tener* var. *tener*, *Atriplex persistens*, *Gratiola heterosepala*, *Juncus leiospermus* var. *ahartii*, *Legenere limosa*, *Myosurus minimus* var. *apus*, *Navarretia myersii* ssp. *deminuta*, *Plagiobothrys hystriculus*
4.1.3.2.2	Annual grass	*Orcuttia inaequalis*, *Neostapfia colusana*, *Orcuttia pilosa*, *Orcuttia tenuis*, *Orcuttia viscida*, *Tuctoria greenei*, *Tuctoria mucronata*
4.1.3.2.3	Biennial/ perennial herb	*Eryngium constancei*, *Eryngium spinosepalum*

4.1.3.3 Implement research on branchiopod dispersal mechanisms

4.1.3.3.1 Listed fairy shrimp and vernal pool tadpole shrimp (Priority 1)

4.1.3.3.2 Non-listed fairy shrimp (Priority 3)

4.1.3.4 Implement research on Delta green ground beetle dispersal mechanisms (Priority 1)

4.1.3.5 Implement research on western spadefoot toad dispersal mechanisms (Priority 2)

4.1.4 Conduct research on biology and ecology of each species, as necessary, to determine optimum vernal pool preserve size, optimum buffer width, and genetic variability necessary to support recovery and long-term conservation efforts.

Preparation required prior to conducting this action includes compiling and reviewing existing literature on the relevant biology and ecology of the covered species.

4.1.4.1 In coordination with us, determine and prioritize research needed to inform management and habitat protection decisions. (Priority 2)

4.1.4.2 Conduct research based on priorities ensuring that the research is essential to the recovery or long-term conservation of the species. (Priority 2)

4.1.5 Conduct research on the effects of environmental factors, as necessary, affecting the recovery and long-term conservation of vernal pool species.

Research aspects pertinent to vernal pool species recovery and long-term conservation (*e.g.*, threat amelioration for reintroduction sites, choosing appropriate sites for introductions, *etc.*) include: the range of environmental tolerances of vernal pool animal species to physical (*e.g.*, temperature, depth) and chemical (*e.g.*, pH) characteristics of vernal pools, including synergistic effects, across full geographic range, and environmental conditions such as vernal pool type, soil type, and landform, at current and historical occurrences of each taxon.

Preparation required prior to conducting this action includes compiling and reviewing existing literature on the range of environmental tolerances of the covered species.

4.1.5.1 In coordination with us, determine and prioritize research needed to inform management and habitat protection decisions. (Priority 2)

Priorities should be given to species that will be reintroduced or introduced, or to species for which defining potential habitat and locating new populations is important.

4.1.5.2 Conduct research based on priorities ensuring that the research is essential to the recovery or long-term conservation of the species. (Priority 2)

4.1.6 Perform Population Viability Analysis, demographic monitoring/modeling or other analyses as appropriate to evaluate the probability of long-term survival, adequacy of management and efficacy of recovery criteria.

Population viability analysis and demographic modeling is the use of quantitative methods to analyze the environmental and demographic factors that affect the survival of populations. Population viability analyses and demographic modeling usually require detailed and specific life history information, such as recruitment, survival, reproductive rates, mortality, and immigration and emigration rates. Some models also require detailed information on extinction and recolonization rates of metapopulations. Modeling of a population's viability over the long-term also requires an understanding of environmental factors (natural or human-made) that affect the populations, their impacts, and their probabilities of occurrence.

Population viability analyses may be used to refine recovery criteria and actions in a number of ways. Population viability analyses may be used to estimate time to extinction to indicate urgency of recovery efforts; establish parameters that should be examined for long-term population monitoring; assess monitoring data to determine recovery success; and identify particular life history stages or demographic processes that are sensitive to management actions or to particular threats and that may require specific management. Population viability analyses or demographic monitoring may not be appropriate or feasible for all species or for all populations of an individual species. The long-lived seed and cyst stages of many of the species addressed in this plan may be especially difficult to model because of the difficulty in gathering data adequate to characterize population size and demography of these life stages. Examination of feasibility of conducting analyses and application of analyses to refining management, recovery criteria and actions, and threat reduction actions is required

before expending resources as these actions may be very time- and resource-intensive.

Preparation required prior to conducting this action includes a thorough review of existing literature on performing population viability analyses or demographic modeling. In addition, data gaps must be identified. In coordination with us, it must also be determined whether a population viability analysis, or demographic monitoring approach, is appropriate or feasible, and readily applicable to refinement of management actions, recovery criteria and actions, and methods used to reduce threats.

During this preparation, rarity of species, risk of losing them, management sensitivity/conflicting uses, suitability of the species to the techniques, and availability of monitoring and research resources should be considered. Also considered should be species life histories and whether species demographics are easily monitored and characterized (difficult for species with long-lived seedbanks, very short or very long life-spans, episodic reproduction, or large populations on heterogeneous habitats). The number and types of assumptions that must be made to conduct a model and likelihood of validity of assumptions (*e.g.*, model assumes no immigration, but no data exists for the species and you suspect dispersal via grazing animals) should be considered.

If population viability analysis or demographic modeling is appropriate, the types of data that should be collected in order to perform the population viability analysis or modeling and develop demographic monitoring or data collection plans need to be determined.

Types of population viability analyses vary in the complexity, quantity, and types of data needed. Prior to initiating efforts to develop a population viability analysis or demographic monitoring program, the adequacy of existing data for conducting population viability analyses should be evaluated. In addition, the types of data that research methodologies can effectively gather should be examined to determine the types of population viability analyses that can

realistically be conducted for the species. Finally, appropriate data necessary to conduct population viability analyses into population monitoring and other research activities needs to be collected..

4.1.6.1 In coordination with the Sacramento Fish and Wildlife Office, develop a prioritized list of species that would benefit the most from conducting a population viability analysis. (Priority 2)

4.1.6.2 Conduct population viability analyses as sufficient data is accumulated and apply results to refine recovery actions and criteria, habitat management, and threat reduction actions. (Priority 2)

As sufficient data is gathered, population viability analyses should be conducted and used to evaluate the status of the covered animal populations and modify recovery criteria and recovery actions where appropriate.

4.2 Conduct research on the effects of habitat management practices on vernal pool species and their habitat, and incorporate into management plans developed under Action 2.2.

4.2.1 Conduct research to determine minimum reserve size in order to maintain ecosystem function and population viability of vernal pool species. (Priority 3)

Limiting factors of vernal pool plants, vernal pool branchiopods, the delta green ground beetle, and western spadefoot toad should be considered in determining minimum reserve sizes.

4.2.2 Determine the role and effects of fire in functioning vernal pool ecosystems in relation to component native species. (Priority 3)

4.2.3 Determine the role and effects of livestock grazing in functioning vernal pool ecosystems in relation to component native species. (Priority 3)

Since much of the existing vernal pool habitat is currently grazed, adaptively manage the grazing to maintain ecosystem function.

4.2.4 Conduct research into techniques and determination of success criteria for enhancement, restoration, and creation, including feasibility of reintroductions and introductions.

4.2.4.1 Preparation required prior to conducting this action includes compiling and reviewing existing literature on vernal pool enhancement, restoration, and creation.

4.2.4.2 Modify ecologically-based success criteria for enhancement, restoration, and creation (Action 2.4) that define functional vernal pool ecosystems, as necessary, as results from research and monitoring become available. (Priority 3)

4.2.4.3 Develop hydrologic models to predict effects of hydrologic modifications in various situations. (Priority 3)

4.2.4.4 Investigate methods for restoring vernal pool ecosystems that have been degraded by human activities and incorporate results into restoration and management plans. The goal of restoration will be to achieve the level of function defined through Action 4.2.4.2.

4.2.4.4.1 Investigate methods for restoring vernal pool ecosystems that have been degraded by alterations in topography or hydrology, such as leveling, draining, temporary and permanent impoundments, inundation by runoff, contaminants, or inundation by wastewater application. (Priority 3)

4.2.4.5 Conduct research on use of created vernal pool wetlands by vernal pool species and compare with natural wetlands. (Priority 3)

4.3 Conduct research on threats to vernal pool species and ecosystems.

4.3.1 Research the effects of environmental contaminants on vernal pools, ecosystem function, and individual species. (Priority 2)

Scientific studies should be conducted to determine the tolerance of listed animals and animal species of concern to contaminants. Contaminants that vernal pool species typically may come in contact with include pesticides and herbicides and those found in urban and agricultural runoff (oil, fertilizers, dust, *etc*.).

4.3.2 Investigate methods for remediating contamination by toxic substances and restoring vernal pool ecosystems and implement methods at the following sites:

4.3.2.1 Lead at the former Castle Air Force Base. (Priority 2)

4.3.2.2 Herbicides, salt, and industrial chemicals at Davis Communications Annex. (Priority 1)

4.3.2.3 Poultry manure at Arena Plains Unit of Merced National Wildlife Refuge. (Priority 2)

4.3.2.4 Other contaminated vernal pool sites identified through threats monitoring activities. (Priority 2)

4.3.3 Study impacts of low frequency noises and vibrations on the western spadefoot toad. (Priority 3)

4.3.4 Determine influence of nonnative aquatic vertebrate predators (bullfrogs, mosquitofish) on population dynamics and determine habitat protection and management strategies across full geographic range of vernal pool branchiopods, delta green ground beetle and the western spadefoot toad. (Priority 3)

4.3.5 Determine pollinators and their habitat requirements of vernal pool plants to ensure that essential pollinator populations are not lost. Incorporate results into reserve design and habitat protection and management strategies. (Priority 2)

This action is not necessary for the following taxa because they do not require insects for pollination: *Neostapfia colusana*, *Orcuttia* species, *Tuctoria* species, *Juncus leiospermus* var. *ahartii*, and *Gratiola heterosepala*.

4.3.6 Determine degree of threat from, and identify factors contributing to, excessive grasshopper foraging on specified vernal pool plants and develop remedies.

4.3.6.1 *Neostapfia colusana* (Priority 2)

4.3.6.2 *Orcuttia inaequalis* (Priority 2)

4.3.6.3 *Tuctoria mucronata* (Priority 2)

4.3.7 Investigate methods for controlling invasive plants and restoring vernal pool ecosystems that have been degraded by invasive plants (native or nonnative)

Invasive plants that threaten two or more occurrences of covered taxa are listed below. Competition from other invasive plants may affect individual taxa; these plants are combined under the "other" category below. When an invasive plant threatens a covered taxon that has only one or two extant occurrences, the action is assigned Priority 1.

Methods that should be considered to control invasive plants may include fire, grazing, chemicals, tools, hand-pulling, and restoring hydrology. The approach may vary by site, depending on the potential effect on listed taxa in the area, local concerns such as air quality, and costs. Off-site or greenhouse trials should be conducted before the habitat of rare taxa is manipulated. Results from the research should be incorporated within management plans.

4.3.7.1 Investigate methods to control the following invasive plants: *Crypsis schoenoides* (swamp grass), *Glyceria declinata* (mannagrass), *Lepidium latifolium* (whitetop pepperweed), *Malvella leprosa* (alkali-mallow), *Phyla nodiflora* (lippia), and *Salsola* spp. (Russian thistle). (Priority 1)

4.3.7.2 Investigate methods to control the following invasive plants: *Centaurea solstitialis* (yellow star-thistle), *Convolvulus arvensis* (bindweed), *Eleocharis macrostachya* (spikerush), *Hordeum* spp. (barley), *Lolium multiflorum* (Italian ryegrass), *Medicago polymorpha* (California burclover), *Taeniatherum caput-medusae* (medusahead), *Xanthium strumarium* (cocklebur), and other invasive plants. (Priority 2)

5 Develop and implement participation programs.

We strongly believe that a collaborative approach to the proactive protection and management of vernal pool habitat is critical to achieving the goal of recovery of the listed species and long-term conservation of the species of concern addressed in this recovery plan. An essential component of this collaborative approach is the formation of a single recovery implementation team overseeing the formation and function of multiple working groups formed at the vernal pool region level.

5.1 Form a single vernal pool recovery implementation team.

(Priority 1)

A recovery implementation team consisting of no more than 10 people as a general rule from a variety of backgrounds including, but not limited to, State and Federal agencies, agriculture (ranchers and farmers), industry (*e.g.*, building, oil, *etc.*), and others should be formed to implement actions necessary to recover the listed species and conserve the species of concern addressed in this recovery plan. Since substantial vernal pool habitat occurs on private land, a key to the recovery of the listed species and the conservation of the species of concern is the participation of the private landowners and other interested stakeholders. Any effort to implement recovery actions must include the input and support of private landowners and land managers mentioned above, as well as interested public and stakeholders, species experts, professional and academic

researchers, the California Department of Fish and Game, the California Department of Forestry and Fire Protection, California Native Plant Society, the Biological Resources Division of the U. S. Geological Survey, the Bureau of Land Management, the Bureau of Reclamation, and the U. S. Fish and Wildlife Service. Additionally, for technical advice, the invitation and participation should include invertebrate zoologists, herpetologists, botanists, ecologists, range scientists, fire effects experts, and other experts as appropriate.

The recovery implementation team's mission should be to establish working groups and ensure recovery is being implemented for each vernal pool region through habitat protection and management, species and habitat monitoring, completion of research actions, revising suitable species habitat maps and core area boundaries as new information becomes available, and a strong public participation and outreach program. Additionally, the recovery implementation team should advise us of their needs and the needs of the working groups, and offer recommendations from current projects and monitoring results to improve the recovery process for the species addressed in this recovery plan. The recovery implementation team may be utilized to assist us in updating the recovery plan in the future.

5.2 Form individual working groups for vernal pool regions and develop participation plans for private landowners, non-governmental target audiences, and Federal, State, and local agencies to promote the recovery of listed species and long-term conservation of the species of concern addressed in this recovery plan.

5.2.1 Form individual working groups for each vernal pool region. (Priority 1)

The recovery implementation team should form vernal pool region working groups for each vernal pool region, or in the case of smaller vernal pool regions or geographically isolated or distinct vernal pool regions, two or more vernal pool regions can be combined under the responsibility of a single working group. A vernal pool region working group should work cooperatively to implement specific actions necessary to recover the listed species and conserve the species of concern addressed in this recovery plan.

Additionally, working groups should provide the recovery implementation team with a participation plan and with annual reports of activities including recommendations for future recovery actions or changes to existing actions to benefit species.

5.2.2 Develop a participation plan and submit to recovery implementation team for review. (Priority 3)

5.2.3 Develop participation and outreach programs for private landowners.

The outreach program should focus on providing information to interested and affected landowners about 1) the Endangered Species Act, 2) endangered species recovery, 3) vernal pool habitats and species, 4) species covered in this recovery plan, 5) the need for protection and management of vernal pool habitat, 6) how recovery can be achieved, including economic incentives for conservation of rare species, and 7) any vernal pool region-specific issues.

An effective participation and outreach program will 1) promote programs and activities that give private landowners a feeling of "ownership" in the vernal pool recovery process. Rather than dictating to landowners what they must do, an effective participation and outreach program will foster and support a relationship with landowners that deals with what a landowner is capable of doing on their lands; 2) assist landowners in becoming familiar with special status plant and animal species that occur on their land, 3) provide landowners with information, assistance, and access to conservation tools (*e.g.,* Safe Harbor Agreements) that promote the recovery and long-term conservation of the species addressed in this recovery plan, and 4) compile, review (and/or develop), and make available to landowners incentive programs that encourage landowners to assist in endangered species recovery and conservation.

Preparation required prior to conducting this action includes compiling and reviewing existing outreach material targeted for private landowners. It may be necessary to revise

existing outreach materials, or develop new outreach materials for private landowners.

A mechanism (*e.g.*, funding, *etc*.) should be established to initiate an effective participation and outreach program for private landowners, then outreach materials should be distributed through existing outreach mechanisms (*i.e.* newsletters, the Internet, annual meetings of organizations, public meetings).

5.2.3.1 Identify private landowners interested in pursuing recovery and conservation efforts on their lands and prioritize a list of potential participants. **Table IV-8** can be used to supplement the prioritized list. (Priority 3)

5.2.3.2 Assist private landowners in identifying sources of funding for pursuing conservation easements on their lands. (Priority 3)

5.2.3.3 Work with private landowners to develop Safe Harbor Agreements, Candidate Conservation Agreements, Memoranda of Understanding, Habitat Conservation Plans, or other appropriate tools for conserving listed species or species of concern on their lands. (Priority 3)

5.2.3.4 Work with cities, counties, and owners of large amounts of natural lands to develop Habitat Conservation Plans, for conserving listed species or species of concern on their lands. (Priority 2)

City and county governments, as the primary agencies making land use decisions, need to be involved in recovery planning. Cooperative programs should encourage and promote the development of Habitat Conservation Plans for cities and counties in the area covered by this recovery plan. Similarly, owners of large amounts of natural lands should be encouraged to participate in conservation planning.

Table IV-8. Potential landowner agreements on conservancy land.

Agency	Species	Priority
Center for Natural Lands Management	*Atriplex persistens*	3
Merced County Farm Trust	*Eryngium spinosepalum*	3
Sierra Foothill Conservancy	*Gratiola heterosepala*	3
Solano County Farmlands and Open Space Foundation	*Astragalus tener* var. *ferrisiae*	1
Solano County Farmlands and Open Space Foundation	*Astragalus tener* var. *tener*, *Atriplex persistens* *Gratiola heterosepala* *Legenere limosa*	3 3 3 3
The Nature Conservancy	*Gratiola heterosepala* *Legenere limosa* *Myosurus minimus* var. *apus*	3 3 3
Trust for Wildland Communities	*Gratiola heterosepala* *Legenere limosa*	3 3
Various Conservancies	For other species as determined by actions 3 and 4.	3

5.2.4 Develop specialized programs to facilitate cooperation and information dispersal/exchange to target audiences (*e.g.,* California Farm Bureau, University of California Cooperative Extension, Resource Conservation Districts, County and City Planners, California Builders Association, professional societies, *etc.*).

Preparation required prior to conducting this action includes compiling and reviewing existing audience appropriate materials and, if necessary, developing new or additional materials. Also, funds should be allocated to initiate cooperative programs with audience organizations.

5.2.4.1 Initiate cooperative programs with audience organizations. (Priority 3)

5.2.4.2 Develop Safe Harbor Agreements, Candidate Conservation Agreements, Memoranda of

Understanding, or other appropriate documents for conserving taxa of concern on conservancy lands (see **Table IV-8**). (Priority 3)

5.2.5 Develop and implement cooperative programs and partnerships with Federal, State, and local agencies to ensure they utilize their authorities to the fullest extent possible to promote the recovery of listed species and the long-term conservation of the species of concern addressed in this recovery plan.

5.2.5.1 Develop tools such as Candidate Conservation Agreements, Memoranda of Understanding, or other appropriate documents for conserving taxa of concern on public lands.

5.2.5.1.1 Develop Priority 1 agreements with landowners/land managers (**Table IV-9**).

5.2.5.1.2 Develop Priority 2 agreements with landowners/land managers (**Table IV-9**).

5.2.5.1.3 Develop Priority 3 agreements with landowners/land managers (**Table IV-9**).

5.2.5.2 Assist lead agencies and districts in incorporating provisions of this recovery plan in local decision-making (*e.g.*, General/Specific Plans, mosquito- and flood-control districts). (Priority 3)

Table IV-9. Potential landowner/land manager agreements on public land.

Agency	Species	Priority
California Department of Fish and Game	*Astragalus tener* var. *ferrisiae*	1
California Department of Fish and Game	*Astragalus tener* var. *tener* *Atriplex persistens* *Eryngium spinosepalum* *Gratiola heterosepala* *Legenere limosa* *Myosurus minimus* var. *apus*	3 3 3 3 3 3
California Department of Parks and Recreation	*Astragalus tener* var. *tener* *Atriplex persistens*	3 3
California Department of Transportation	*Eryngium spinosepalum*	3
California Department of Water Resources	*Eryngium spinosepalum* *Myosurus minimus* var. *apus*	3 3
U.S. Army Corps of Engineers	*Eryngium spinosepalum*	3
U.S. Bureau of Land Management	*Gratiola heterosepala* *Legenere limosa* *Myosurus minimus* var. *apus*	3 3 3
U.S. Department of Defense	*Astragalus tener* var. *tener* *Myosurus minimus* var. *apus*	3 3
U.S. Forest Service (Lassen and Modoc National Forests)	*Gratiola heterosepala*	3
Don Edwards San Francisco Bay National Wildlife Refuge	*Lasthenia conjugens* vernal pool tadpole shrimp	3 3
Merced National Wildlife Refuge Complex	*Astragalus tener* var. *tener* *Atriplex persistens*	3 3
Sacramento National Wildlife Refuge Complex	*Astragalus tener* var. *ferrisiae*	1
Sacramento National Wildlife Refuge Complex	*Atriplex persistens*	3
Sacramento River National Wildlife Refuge	*Astragalus tener* var. *ferrisiae*	1
City of Oroville	*Juncus leiospermus* var. *ahartii*	2
City of Woodland	*Astragalus tener* var. *tener*	3
County of Riverside	*Myosurus minimus* var. *apus*	2
County of Sacramento	*Gratiola heterosepala* *Legenere limosa*	3 3
County of Sacramento	*Juncus leiospermus* var. *ahartii*	2
County of San Diego	*Myosurus minimus* var. *apus*	3
Kern County Water Authority	*Myosurus minimus* var. *apus*	3
Sacramento Municipal Utility District	*Legenere limosa*	3

5.2.6 Develop trained personnel to facilitate protective measures for vernal pool habitat, provide public education, and respond to emergency situations.

Biologists, docents, volunteers, and other personnel should be trained to patrol vernal pool areas to monitor vernal pools, distribute educational materials, to report to appropriate agencies such emergency situations as vehicles, trash dumping, or ground disturbing activities in vernal pool habitat. Biologists engaged in monitoring, management, or research activities should also advance the public's understanding of vernal pool management needs.

5.3 Review status of covered species and recovery plan implementation.

The recovery implementation team should provide us with a summary of findings following periodic reviews of recovery efforts to determine the amount of progress towards recovery goals. Approval of this recovery plan does not ensure that even the highest-priority actions will be funded. Moreover, certain actions cannot be started until other actions have been completed, and additional recovery criteria may be developed as data accumulate. Actions may need to be re-prioritized if progress is determined to be too slow. Recovery criteria for each will be reconsidered to determine if adjustments or additional criteria are necessary.

5.3.1 Periodically review progress toward recovery of all listed species and identify those species that require a change in status (downlisting, delisting, uplisting) or emergency actions. (Priority 3)

Section 4(c)(2) of the Endangered Species Act requires that we review the status of all listed species at least once every 5 years to determine if changes in status are warranted. However, some taxa addressed in this recovery plan are so rare that we recommend more frequent review (*i.e.,* on a 3 year basis for *Tuctoria mucronata, Navarretia myersii* ssp. *deminuta*, and *Plagiobothrys hystriculus*). The status of taxa that are not currently listed also should be reviewed periodically.

5.3.2 Update maps of suitable species habitat as new information becomes available. Revise core area boundaries to include suitable species habitat or to exclude those areas determined by the Implementation Team to not support suitable habitat. (Priority 3)

5.3.3 Periodically review the status of species of concern and identify those species that require a change in status (*e.g.*, listing). (Priority 3)

Listing of species of concern covered in this recovery plan may be necessary if actions specific to the needs of these species are not undertaken within a reasonable amount of time.

5.3.4 Evaluate progress towards completing recovery actions and adjust recovery implementation efforts accordingly. (Priority 3)

A tracking process should be developed and implemented to track the completion of recovery actions and progress toward delisting, downlisting, or uplisting.